SPECIFICATION NUMBER 116

APRIL 15, 1962

X353-5B PROPULSION SYSTEM ACCEPTANCE TEST SPECIFICATION

VZ-11

LIFT FAN FLIGHT RESEARCH AIRCRAFT PROGRAM

CONTRACT NUMBER DA44-177-TC-715

GENERAL ELECTRIC

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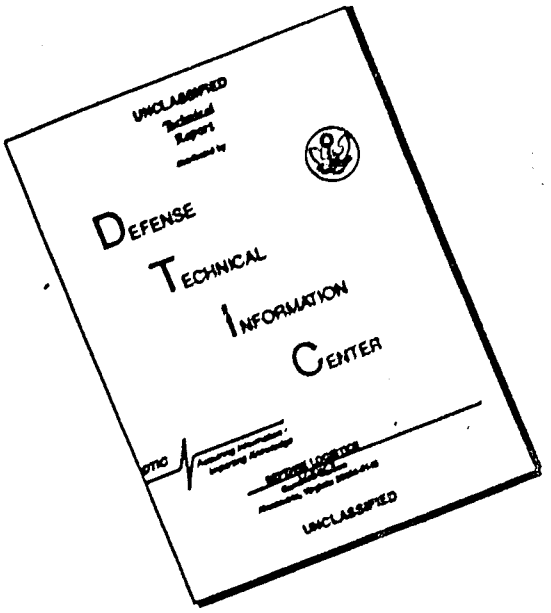

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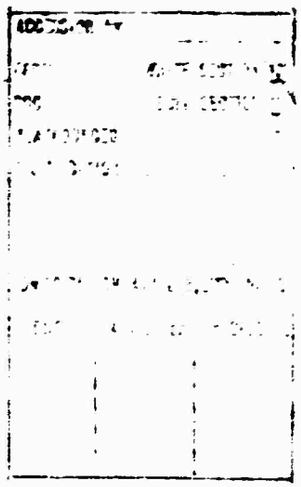


X353-5B PROPULSION SYSTEM

ACCEPTANCE TEST

Specification No. 116

April 15, 1962

May 29, 1962 (Revision)

APPROVAL STATUS: This specification was approved by U.S. Army TRECOM for use on this program with modifications incorporated on pages marked (1) as of May 29, 1962.

GENERAL ELECTRIC COMPANY

FLIGHT PROPULSION LABORATORY DEPARTMENT

CINCINNATI, OHIO

Modification ⟨1⟩ applies to the following pages:

i, 1, 2, 5, 6, 7, 13, 15, 16, and 17.

Spec. No. 116

Date April 15, 1962

Revised May 29, 1962

X353-5B PROPULSION SYSTEM

ACCEPTANCE TEST SPECIFICATION

1. SCOPE

1.1 General. - This specification defines the acceptance test requirements for the lift fan and diverter valve components of the X353-5B convertible, ducted, lift fan propulsion system conforming to Specification No. 112.

2. APPLICABLE DOCUMENTS

2.1 The X353-5B Propulsion System Specification No. 112, and applicable publications from ANA Bulletin 343n form part of this specification in so far as specifically referenced in other paragraphs of this specification.

3. REQUIREMENTS

3.1 This section is not applicable to this specification.

4. QUALITY ASSURANCE PROVISIONS

4.1 General. - All tests defined by this specification shall be conducted at the convenience of the contractor. Systems, components and test apparatus shall be subject to inspection by authorized contracting agency representative(s) who shall be given all reasonable facilities to determine conformance with this specification. All instructions for testing of the propulsion system shall be available to the contracting agency representative(s) prior to the tests.

4.1.1 Accuracy of Data. - For all system and component cali-

brations, evaluated data shall have a steady state accuracy within the tolerances shown below. The instrumentation systems and calibration methods used by the contractor shall be subject to the approval of an authorized contracting agency representative. Calibrations shall be performed as often as necessary in the judgement of the contractor to insure the required degree of accuracy is maintained. Corrected performance data will include instrument system calibrations where appropriate in the judgement of the contractor.

ITEM OF DATA	
Fan speed	± 0.5 per cent of maximum rated speed
Gas generator speed	± 0.5 per cent of maximum rated speed
Fan thrust	± 2.0 per cent of maximum rated thrust
Fuel flow	± 2.0 per cent of maximum rated fuel flow
Major component weight	± 2.0 pounds per major component
Other	Appropriate to the test in the judgement of the contractor

4.1.2 Component Weight. - The weight of each component including all appropriate interface fasteners shall be measured and the center of gravity determined at the time the component is being prepared for test. If the weight is measured with research instrumentation installed, the component weight may be calculated by subtracting the weight of sensors, leads, brackets and other such equipment designated by the contractor as research instrumentation. The subtracted weight shall be substantiated in the test notes.

4.2 Test Conditions. - The test shall be conducted at the ambient conditions of the contractor's plant at Evendale, Ohio in an outdoor facility. Performance calibrations shall be obtained for wind conditions not to exceed [illegible] mph and with the components of the system mounted such that, in the judgement of the contractor, there are no

appreciable effects of ground proximity influencing the ratings.

4.2.1 Lubrication. - The fan bearings shall each be packed with 50 grams of contractor specified grease during initial assembly.

4.2.2 Test Apparatus. -

4.2.2.1 Gas Generator. - The gas generator(s) shall be either a YJ85-GE-5 or J85-GE-5 turbojet engine, less afterburner, used as a "slave" to the system and may be changed and/or maintained to the extent necessary to complete the test. Fuel in accordance with MIL-J-5624D shall be used. Test ducting shall be selected such that, in the judgement of the contractor, system conditions essentially as described in the X353-5B Propulsion System Specification No. 112 shall be maintained as appropriate for test of each major component. The performance of the gas generator(s), ducting, nozzles and other equipment used to provide the conditions of the test shall not affect the acceptance of the lift fan or diverter valve components.

4.2.2.2 Test Arrangement. - The contractor may, at its option, conduct separate or simultaneous tests for acceptance of lift fans and diverter valves. The test arrangement may include one gas generator and one diverter valve providing gas for each section of the lift fan scroll, or two gas generators and two diverter valves in which case excess flow from each gas generator shall be discharged as bleed. In a two gas generator arrangement the diverter valves may be simultaneously acceptance tested, however, deviations in performance or post-test condition of either of the valves shall not affect the acceptance of the other valve or the lift fan component. The contractor may conduct lift fan acceptance tests using diverter valves of test type hardware if gas conditions and transients performed would be essentially equivalent to those obtainable with flight type hardware.

4.2.2.3 Test Stand Dynamic Characteristics. - Vibratory amplitudes shall be measured with the propulsion system operating on a test stand which has the following dynamic characteristics: the natural frequencies of the installed propulsion system shall be no higher than 50 per cent of the rated fan speed in all modes of motion which can be excited by residual rotor unbalance.

4.2.3 Starter. - All starts shall be performed with the standard engine air impingement system using the contractor's shop air supply system.

4.2.4 Vibration Measuring Equipment. - The vibration equipment used for the measurement of component vibration shall have frequency response characteristics in accordance with the curves in Figure 1. The actual response of the vibration measuring equipment when calibrated by applying known sinusoidal motion to the pickup shall not deviate from the curves shown in Figure 1 by more than 5 per cent at frequencies up to 1000 cps.

4.2.5 Operating Test Conditions. -

4.2.5.1 Miscellaneous Data. - The date, operating schedule, test system model designation and serial number(s) shall be recorded on each log sheet. Test configuration details shall be included in the general log.

4.2.5.2 Test Notes. - Notes shall be placed on the log sheets of all incidents of the run such as leaks, vibrations, and other irregular functioning of the propulsion system components or the equipment, and of the corrective measures taken.

4.3 Preliminary Runs. - The nature and extent of the running-in prior to the acceptance tests shall be determined by the contractor.

4.3.1 Control Adjustments. - Prior to initiation of the final

run the gas generator control(s) shall be adjusted while installed on the gas generator, using only routine field service adjustments, to produce under sea level static conditions rated lift or higher within the limits of the measured gas temperatures and rotor speeds associated with the ratings. Test data shall be extrapolated to the corrected rating point by application of the ideal fan laws if ambient conditions or the gas generator(s) used in the test preclude actual test demonstration.

4.3.1.1 Trim Bleed Requirement. - A nominal 10.6 per cent diverter valve discharge flow shall be bled from the system during all tests of the lift fan. The bleed flow may, at the contractor's option, be used to power an X376 trim control fan for the purpose of simultaneous test according to the provisions of the X376 Pitch Fan Acceptance Test Specification No. 117. In the event that an X376 fan is simultaneously tested with the X353-5B propulsion system, it shall be subject to independent acceptance and its performance shall in no way affect the acceptance of the X353-5B system or components.

4.3.1.2 Scroll Area Requirement. - The scroll areas of the lift fan shall be trimmed for producing rated gas generator discharge temperature at ambient conditions corresponding to 2500 feet altitude on an ANA 421 standard hot day. For a test arrangement employing two gas generators, the excess flow from each gas generator shall be bled through an overboard duct with an effective area adjusted to maintain rated gas generator discharge temperature and with the available gas horsepower (after trim bleed extraction) being divided equally between the lift fan and the bleed system. For this test arrangement, the following conditions at maximum power shall be established as closely as possible by area adjustment:

a. W_{B_5}* = 0.106 (0.992) (W_2 + W_f)

*W_{B_5} relates to Figure 58, Spec. No. 112 and is equivalent to $W_{18.2}$, Figure 21, Spec. No. 113.

b. $W_{b\ell} = 0.444 (W_a + W_f)$ per gas generator

c. rated gas generator discharge temperature

4.3.1.3 Louver Adjustment. - The lift fan discharge louver position indicator(s) shall be adjusted at the beginning of the test so that zero indicated louver angle yields zero horizontal thrust at the maximum power setting. The actuation system external to the louver connecting rod may be flight or test quality hardware at the contractor's option and its performance shall not affect the acceptance of the lift fan.

4.3.1.4 Diverter Valve Adjustment. - The diverter valve doors shall be adjusted for normal closure at either terminal position. The actuation rate shall be adjusted so that the time for full travel in either direction at maximum power shall not exceed one second.

4.3.1.5 Overspeed Detection and Signalling System. - The fan overspeed detection and signalling system shall be adjusted for 103% rpm limit and shall be operative throughout the test.

4.4 Acceptance Test. - The acceptance test shall be conducted on each lift fan and diverter valve to be delivered to the contracting agency and shall consist of the test periods specified under paragraph 4.4.1. No fan inlet distortion shall be simulated during the test. Recorded time at each test condition shall start upon completion of the discharge louver, power lever, and/or diverter valve movement(s) necessary to obtain the specified condition. The sequence of running the periods listed in 4.4.1.1 may be selected by the contractor.

4.4.1 Acceptance Test Schedule. - The acceptance test schedule shall consist of the following described runs.

4.4.1.1 Initial Run. - The X353-5B major component(s) shall be subjected to an initial run in accordance with the following schedule. The fan discharge louvers shall be positioned for continuous stagger, $\beta_s = 20^\circ$, and zero vector, $\beta_v = 0^\circ$, except as noted. The power lever shall be advanced or retarded, as applicable, in not more than one second:

a. The gas generator shall be started in the turbojet mode accelerated to idle speed and then the diverter valve shall be positioned for the lift mode.

b. Ten minutes with the power lever in the maximum power position (lift mode).

c. Four minutes with the power lever in the maximum power position (turbojet mode).

d. Ten minutes at the maximum power setting (lift mode) consisting of two minutes at each of the following conditions:

$\beta_s = 0^\circ$	$\beta_v = 30^\circ$
$\beta_s = 0^\circ$	$\beta_v = 40^\circ$
$\beta_s = 20^\circ$	$\beta_v = 20^\circ$
$\beta_s = 20^\circ$	$\beta_v = 10^\circ$
$\beta_s = 20^\circ$	$\beta_v = 0^\circ$

e. Ten minutes at 2050 rpm (or peak vibration speed if measured to be other than this specified speed).

f. Six minutes with the power lever at the normal continuous power setting (turbojet mode).

g. Ten minutes consisting of six minutes with the power lever in the maximum power position (lift mode) and four minutes

with the power lever in the idle position (lift mode).

h. The gas generator shall be shut down while in the lift mode for a period of at least five minutes. A start in the turbojet mode, conversion to lift mode at idle and acceleration to maximum power setting (lift mode) shall be made followed by eight minutes of operation during which the power lever shall be in the maximum power position for as much time as necessary to operate at the following transients, the louver actuation time to be selected by the contractor.

(1) Vectoring with $\beta_s = 20^\circ$: $\beta_v = 0^\circ$

$\beta_v = 40^\circ$

$\beta_v = 0^\circ$ ($\beta_v = -10^\circ$ optional)

(2) Spoiling with $\beta_v = 0^\circ$: $\beta_s = 20^\circ$

$\beta_s = 40^\circ$

$\beta_s = 0^\circ$

(3) Spoiling with $\beta_v = 20^\circ$: $\beta_s = 0^\circ$

$\beta_s = 40^\circ$

$\beta_s = 20^\circ$

(4) Spoiling with $\beta_v = 30^\circ$: $\beta_s = 20^\circ$

$\beta_s = 25^\circ$

$\beta_s = 10^\circ$

(5) Spoiling with $\beta_v = 45^\circ$: $\beta_s = 10^\circ$

$\beta_s = 25^\circ$

$\beta_s = 20^\circ$

Any remaining time of the eight minute period shall be run at the idle power setting (lift mode).

i. Two minutes consisting of the following transients:

(1) Turbojet acceleration, lift mode: idle to maximum power setting.

(2) Turbojet deceleration, lift mode: maximum to idle power setting.

(3) Conversion lift to turbojet mode: idle power setting.

(4) Turbojet acceleration, turbojet mode: idle to maximum power setting.

(5) Conversion turbojet to lift mode: maximum power setting.

(6) Conversion lift to turbojet mode: maximum power setting.

(7) Turbojet deceleration, turbojet mode: maximum to idle power setting.

Any remaining time of the two minutes period shall be run at the idle power setting (turbojet mode).

4.4.1.1.1 Initial Run Allowances. - The initial run may be interrupted at any point to make adjustments, inspections or perform normal line maintenance and minor part replacement not requiring component disassembly and which is not, in the contractor's judgement, required because of a functional operating fault without penalty to the accumulated test time except if the interruption occurs to transient runs 4.4.1.1 h or i in which case a repetition of the transient run during which interruption occurs shall be required.

4.4.1.2 Inspection after Initial Run. - Upon completion of the initial run the component(s) shall be inspected without requiring dis-

assembly unless appropriate in the judgement of the contractor. The visual inspection shall include, as applicable, at least the following items:

ITEM OF INSPECTION		
Inlet	Vanes and Struts	material and weld fatigue
		missing or loose hardware
Front Frame	Bulletnose	security of cross vane attachments
		material or weld fatigue inside the bulletnose area
		excessive grease seal leakage
	Air Seal	abnormal rubs
		loose or shifted seal segments
	Mounts	alignment
		missing or loose hardware
		discoloration
	General	dents, tears, cracks, buckling
		instrumentation and fastener security
Scroll	Insulation	discolorations
		loose or damaged blankets
	Air Seals	evidence of separation or exceeding overlap limits
		shifted or dislodged segments
	Mounts	snap ring integrity
		alignment
		discoloration
		scoring
	General	loose turnbuckles
		nozzle condition from discharge side

ITEM OF INSPECTION		
Rotor	Buckets	trailing edge F.O.D., hot spots
		shroud damage, wear - indi-
		cation of rubbing stator or
		insulation
		accumulations
	Torque Bands	cracks, scratches
		distortion
		evidence of rubbing
	Covers	security
		F.O.D.
	Blades	nicks, scratches, cracks
		accumulations
		instrumentation security
	Platforms	material or weld fatigue
		cracks, tears, separations
	General	rotor runout
		unusual noises with rotation
Rear Frame	Stators	nicks, dents
		braze integrity
		hot spots
	Air Seal	abnormal rubs
		loose or shifted seal segments
	Insulation	discolorations
		loose or damaged blankets
	General	expansion joint integrity
		cracks, tears
		distortions
		fastener security
Exit Louvers	Actuation	binding
		security
		play

ITEM OF INSPECTION		
	General	tip shake
		F.O.D.
		hot spots
		distortions, buckling,
		cracks and tears
Diverter Valve	Body	hot spots
		insulation security
		instrumentation security
	Doors	weld integrity, hot spots
		heat shield condition
		seal jamming, wear
	Actuation	leaks
		brackets cracks
		scoring, yielding
Operating Instrumentation	T/C Resistance	electrical check
	T/C Continuity	electrical check
	Vibratory Pickups[a]	respond to displacement
	Speed Pickups	operating at end of test
	Position Indicators	operating at end of test

If any part is found to be defective, an approved part shall be supplied to replace it. Rework or repair subject to the limitations specified in the X353-5B Maintenance Instructions may be accomplished at the contractor's option provided the parts are not worn or defective to an extent which will prevent their being reconditioned sufficiently to enable them to pass the detailed inspection required for similar unused parts; allowance for normal operation as defined by the standard on acceptability of conditions after operation, included in the X353-5B Propulsion System Installation, Operating and Maintenance Instructions, shall be applied.

4.4.1.3 Penalty Run. - The maximum penalty run shall be a complete

[a]Optional

repetition of the initial run. Any part(s) replaced or repaired because of a fault which occurs as a result of operation and is directly attributable to the part(s) quality or design shall be subject to a maximum penalty run. Expendable items such as nuts, bolts, brackets, etc., replaced because of non-functional operating faults do not require penalty testing. A penalty schedule for parts replacement or repair because of non-functional operating faults requiring less than a maximum penalty shall be approved by the contracting agency.

4.4.1.4 Inspection after Penalty Run. - Upon completion of any penalty run, the replaced or repaired part(s) shall be inspected according to 4.4.1.2 as applicable. Additional penalty runs in the event of additional parts replacement or repair in order to satisfactorily complete the initial run shall be allowed subject to 4.6.3.

4.4.1.5 Running-in Prior to Final Run. - The nature and extent of running-in, if any, prior to the final run shall be determined by the contractor. A cleaning procedure recommended for field use by the contractor and approved by the contracting agency may be applied.

4.4.1.6 Final Run. - The final run shall consist of the initial run of 4.4.1.1 except that the time duration required for each steady state power setting shall be half that required in the initial run. If facility utilization would be improved, the final run may, at the contractor's option, require the same time durations as the initial run to enable the simultaneous initial run of one component with the final run of another, subject to 4.6.3.

4.4.2 Not Applicable

4.4.3 Data. - During the tests specified in 4.4.1.1 and 4.4.1.6, the data defined in 4.4.3.1, 4.4.3.2 and 4.4.3.3 shall be recorded.

4.4.3.1 Steady-State Data. - Except for the transient runs, the following data shall be recorded where applicable once during each test period:

Time of day

Total accumulated time, hours:minutes (a separate log for accumulated time on replacement parts shall also be maintained)

Ambient dry bulb temperature, ^{o}F

Ambient wet bulb temperature, ^{o}F

Wind velocity, mph

Wind direction

Power lever position, degrees

Fan discharge louver position (β_1 and β_2), degrees

Diverter valve position, degrees

Scroll area, sq. in.

Cruise nozzle area, sq. in. } if readjusted

Data for determining trim bleed flow

Gas generator(s) rotor speed, rpm

Fan rotor speed, rpm

Vertical lift, lb.

Horizontal thrust, lb.

Fuel consumption, lb/hr.

Data for determining gas generator(s) air flow

Gas generator inlet total temperature, ^{o}F

Fan inlet total temperature, ^{o}F

Gas generator turbine discharge total pressure, psig

Gas generator turbine discharge total temperature, EGT, ^{o}F

Gas generator and fan vibrations, mils peak to peak

Fan bearing temperature, ^{o}F

Optional:

J85 lube oil temperature, ^{o}F

J85 lube oil pressure, psig

J85 compressor discharge pressure, psig

Fuel manifold pressure, psig

All stops shall be indicated and at least once during each test fuel specific gravity shall be recorded.

4.4.3.1.1 Ambient Conditions. - Approval of the contracting agency shall be obtained for location of the barometer pressure and ambient temperature measuring devices. A minimum stabilization time of two hours shall precede any readings for performance checks. Ambient conditions shall be read and recorded at intervals not exceeding one hour.

4.4.3.2 Transients Data. - For each transient performed in 4.4.1.1 "i", the maximum values of measured gas generator T_5 harness temperature, fuel flow, gas generator speed, fan speed and power lever or diverter valve position attained during the transient shall be read and recorded. Periodic checks of fuel boost pressure and diverter valve actuator pressure shall be read and recorded throughout the test.

4.4.3.3 Starting data. - Applicable for acceptance test of diverter valve components only; for each start performed, the time required from initiation of the start to ignition, to starter cutout and to stabilized idle rpm, the maximum measured T_5 harness temperature, and any noticeable "flat" spots in the acceleration curve shall be recorded.

4.4.4 Stoppages. - Stoppage from any cause, other than required by test schedule, during the final run shall require a complete repetition of the final run. If on close inspection at the completion of the last test run any discrepancy is found which would normally result in a stoppage if known, a complete rerun after the discrepancy is corrected shall be required.

4.4.5 Overspeed Detection and Signalling System Check. - Once

during the acceptance test of the lift fan, the overspeed detection and signalling system shall be adjusted for 90% rpm limit for demonstration of signalling action. Demonstration of signalling action shall be accomplished by first establishing maximum thrust in the turbojet mode and then accomplishing a power transfer to the lift mode with diverter valve movement in not more than one second. The overspeed detection and signalling system shall be considered a separate system component subject to satisfactory test and shall not affect the acceptance of lift fan or diverter valve components.

4.5 Performance. - During the final run at least one set of observed data shall be corrected to determine comparative X353-5B propulsion system performance and the corrected data shall demonstrate compliance with the following portions of Specification No. 112:

a. Performance ratings (Tables I and II)

b. Dry weight of components (Table VIII except the J85-5 gas generator, J85 governor, and conical nozzle).

All data concerned with the evaluation and determination of performance characteristics shall be corrected for instrument calibrations. Previously accepted components shall not be subject to retest upon recalibration of the test stand. Section "a" of this paragraph shall not apply to diverter valve components tested separately from a lift fan.

4.6 Rejection and Retest. - Whenever there is evidence that a lift fan or diverter valve(s) subject to the acceptance test is malfunctioning or is not meeting Specification No. 112 requirements, the difficulty shall be investigated and its cause corrected to the satisfaction of the contracting agency before the test will be considered completed. If such investigation requires disassembly involving any part of the lift fan or diverter valve(s), as applicable, the portion

of the test in which the difficulty was encountered shall be repeated. After the final run, inspection according to 4.4.1.2 plus the following items shall be required to establish conformance with the standard on acceptability of conditions after operation included in the X353-5B Propulsion System Installation, Operating and Maintenance Instructions:

	ITEM OF INSPECTION	
Scroll	Nozzles	leading edge condition
		hot spots
	Struts	buckling, nicks, dents
	Skin	buckling
		cracks, tears
		hot spots
Rotor	Shaft	bearing play
Diverter Valve	Body	buckling
		hot spots
		cracks, tears

4.6.1 Overspeed Detection and Signalling System Rejection and Retest. - When the overspeed detection and signalling system fails to satisfactorily complete 4.4.5, all subsequent detection and signalling systems shall at the discretion of the contracting agency be tested in accordance with 4.2.2.1.2 of Specification No. 114 until three consecutive units have passed the test without reworking. Units which have been rejected may be reworked to correct the defects and resubmitted for testing. Before resubmitting, full particulars concerning previous rejection and the action taken to correct the original defects shall be furnished the contracting agency.

4.6.2 Component Vibration. - When the lift fan component exceeds the maximum permissible displacements as specified in 3.17 of Specification No. 112, it shall be considered that a malfunction has occurred.

4.6.3 Maximum Hours of Running. - If any lift fan or diverter valve requires more than 15 hours of running with EGT above 1000°F to complete the quality assurance provisions defined in this specification, including preliminary runs or running-in when performed, it shall stand rejected. Parts from these rejected components may be used in re-assemblies or other assemblies, provided these parts are not worn or defective to an extent which will prevent their being reconditioned sufficiently to enable them to pass the detailed inspection required for similar unused parts with allowance for normal operation condition. Parts shall not be resubmitted for testing without full particulars being given the contracting agency concerning previous rejection of the component.

4.6.4 Over Temperature. - If at any time the temperature exceeds the maximum allowable transient temperatures specified in 3.4.15, Specification No. 112, this shall be considered a malfunction. Before the test is considered to be completed a "hot section" inspection without disassembly and excluding the gas generator shall be conducted to determine if all parts are satisfactory.

4.7 Acceptance Test Log Sheets. - The contractor shall retain copies of the acceptance test log sheets for each component for a period of two years. Copies of test sheets shall be furnished to the contracting agency upon request.

4.8 Not Applicable

4.9 Data Correction. - Readings of thrust, rpm, airflow rate, fuel flow rate, gas pressures, and gas temperatures shall be corrected to ARDC standard sea level atmpspheric conditions: Correction for humidity effect will be applied when appropriate in the judgement of the contractor. In order to determine conformance with system performance ratings, the data shall be adjusted for any difference between the test gas conditions and Specification No. 112 estimated gas conditions. Corrected values shall be obtained as follows:

Corrected temperature, $T_c = T \left(\frac{518.688}{T_{inlet}}\right) = \frac{T}{\theta}$

Corrected pressure, $P_c = P \left(\frac{14.696}{P_{inlet}}\right) = \frac{P}{\delta}$

Corrected fan speed, $N_{fc} = N_f \sqrt{\frac{518.688}{T_{t_{10.0}}}} = \frac{N_f}{\sqrt{\theta_{10.0}}} \times C_{1h}$

where: C_{1h} is the humidity correction, Figure 2a.

Corrected g.g. speed, $N_{gc} = N_g \sqrt{\frac{518.688}{T_{t_{2.0}}}} \times C_{1h} = \frac{N_g}{\sqrt{\theta_{2.0}}} \times C_{1h}$

Corrected g.g. thrust, $F_{gc} = F_g \frac{14.696}{P_{t_{2.0}}} \times C_{2h} = \left(\frac{F_g}{\delta_{2.0}}\right) \times C_{2h}$

where: C_{2h} is the humidity correction, Figure 3a.

Corrected fan thrust, L_c (also horizontal thrust) $= L \left(\frac{14.696}{P_{t_{10.0}}}\right) C_{3h} = \frac{L}{\delta_{10.0}} \times C_{3h}$

where: C_{3h} is the humidity correction, Figure 2b.

Corrected g.g. airflow, $W_{ac} = W_a \left(\frac{14.696}{P_{t_{2.0}}}\right) \sqrt{\frac{T_{t_{2.0}}}{518.688}} \times C_{4h} =$

$$\frac{W_a \sqrt{\theta_{2.0}}}{\delta_{2.0}} \times C_{4h}$$

where: C_{4h} is the humidity correction, Figure 3b.

Exhaust gas temperature, $T_{5.1c} = T_{5.1}\left(\frac{518.7}{T_{t2.0}}\right) C_{5h} = \frac{T_{5.1}}{\theta_{2.0}} \times C_{5h}$

where: C_{5h} is the humidity correction, Figure 4a.

Corrected fuel flow, $W_{fc} = W_f \left(\frac{14.696}{P_{t2.0}}\right) \sqrt{\frac{518.7}{T_{t2.0}}} \times C_{8h} =$

$$\frac{W_f}{\delta_{2.0}\sqrt{\theta_{2.0}}} \times C_{8h}$$

where: C_{8h} is the correction for humidity, Figure 4b.

Corrected fuel consumption, $SFC_c = \frac{W_{fc}}{L_c}$
(lift mode)

Corrected fuel consumption, $SFC_c = \frac{W_{fc}}{F_{gc}}$
(turbojet mode)

Corrected horsepower, $HP_{5.1c} = HP_{5.1}\left(\frac{14.696}{P_{t10.0}}\right) \sqrt{\frac{518.7}{T_{t10.0}}} \times C_{7h} =$

$$\frac{HP_{5.1}}{\sqrt{\theta_{10.0}}\,\delta_{10.0}} \times C_{7h}$$

where: C_{7h} is the correction for humidity, Figure 2c

Adjustment for Variation between Test Gas Conditions and Specification No. 112 Estimated Gas Conditions:

a. determine test gas generator flow function, $\left(\frac{W_g\sqrt{T}}{P}\right)_{5.1}$

b. enter Figure 31 Specification No. 112 at level of $HP_{6.1c}$ calculated for test condition

c. determine lift adjustment as difference between lift reading at constant $HP_{6.1c}$ for the test flow function and the line representing $\left(\frac{W_g\sqrt{T}}{P}\right)_{6.1} = 54.64$

d. if not at rated corrected power condition, extrapolate adjusted lift value using the ideal fan laws: $N^3 \alpha F^{2/3} \alpha HP$.

4.9.1 Barometer Correction. - Barometer readings shall be corrected for the difference between mercury temperature and $32^{\circ}F$.

4.9.2 Temperature Sensing System Calibration. - The gas generator gas temperature sensing system for the purpose of adjusting tail pipe temperature and nozzle area shall be a standard YJ85-GE-5 or J85-GE-5 engine T_6 harness, whichever is applicable, located in the diverter valve inlet in the same relative position to the gas generator and engine seal leakage recovery tubes as in the standard engine configuration. For the purpose of fan performance calculations, the indicated temperature shall be compared with a test array of thermocouples located downstream of the diverter valve. Harness calibration shall be in accordance with 4.5.

4.9.3 Bleed Thrust. - The method of accounting for any extraneous thrust from the bleed system(s) shall be provided to the contracting agency upon request.

5. PREPARATION FOR DELIVERY

5.1 Record cards in suitable jackets shall be provided with each component to be delivered providing at least the following information, where applicable:

serial numbers:

assembly

rotor parts

overspeed limiter

accumulated running time including previous history

weight

center of gravity

assembly completion date

acceptance test completion date

part deviations from Specification No. 112

balance data

performance rating at 100% speed

scroll area setting at delivery

exit louver calibration

maximum vibration level

preservation, if any

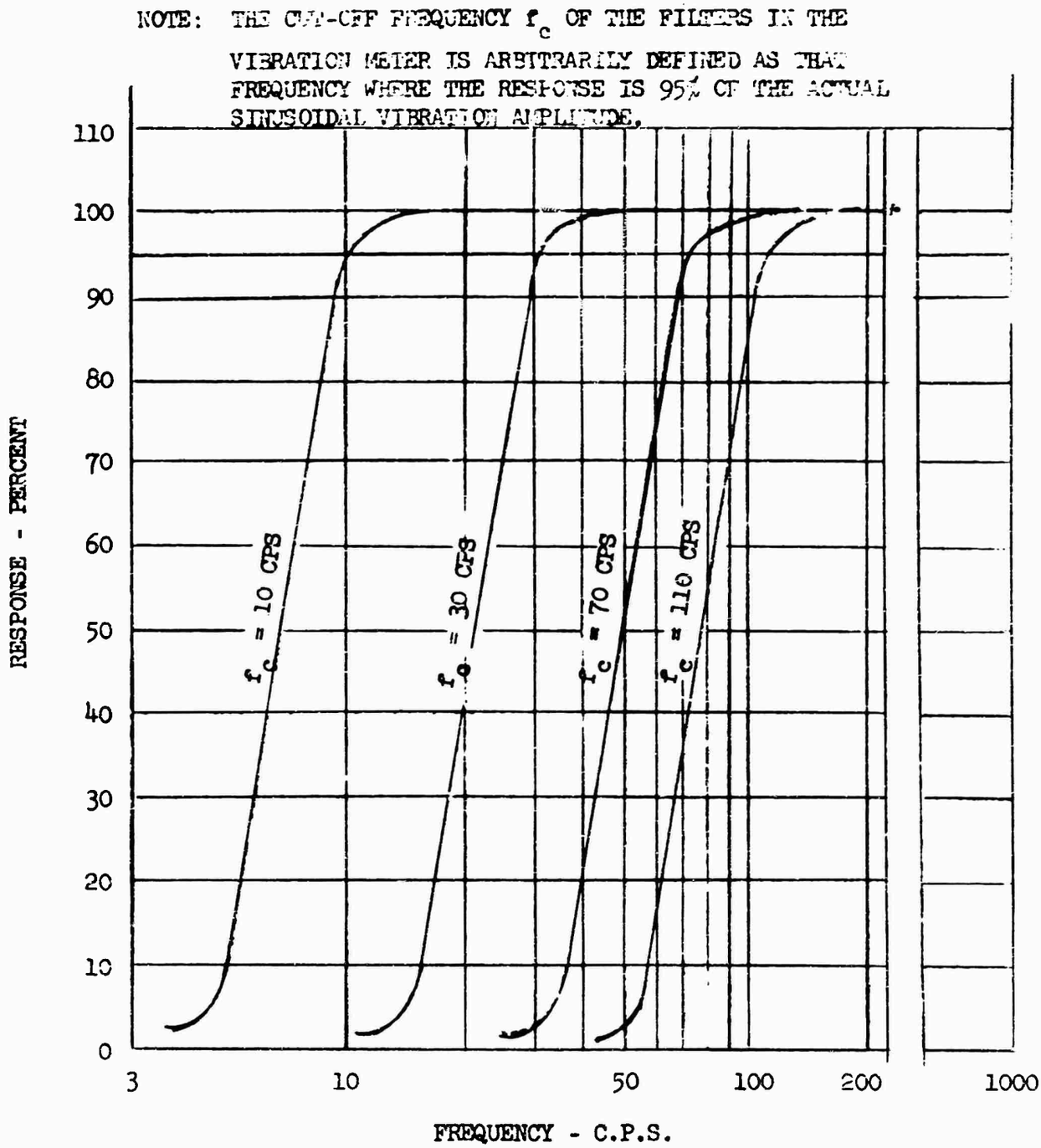
6. NOTES

6.1 Intended Use. - This specification defines the test requirements for a convertible, ducted, lift fan propulsion system intended to demonstrate the quality of each delivered X353-5B major component to be suitable for use by the contracting agency subject to the limitations of Specification No. 114.

6.2 Definitions and Symbols. - The definitions and symbols used in this specification are as specified in the X353-5B Propulsion System Specification No. 112 and, where this is not inclusive, in MIL-E-500[illegible].

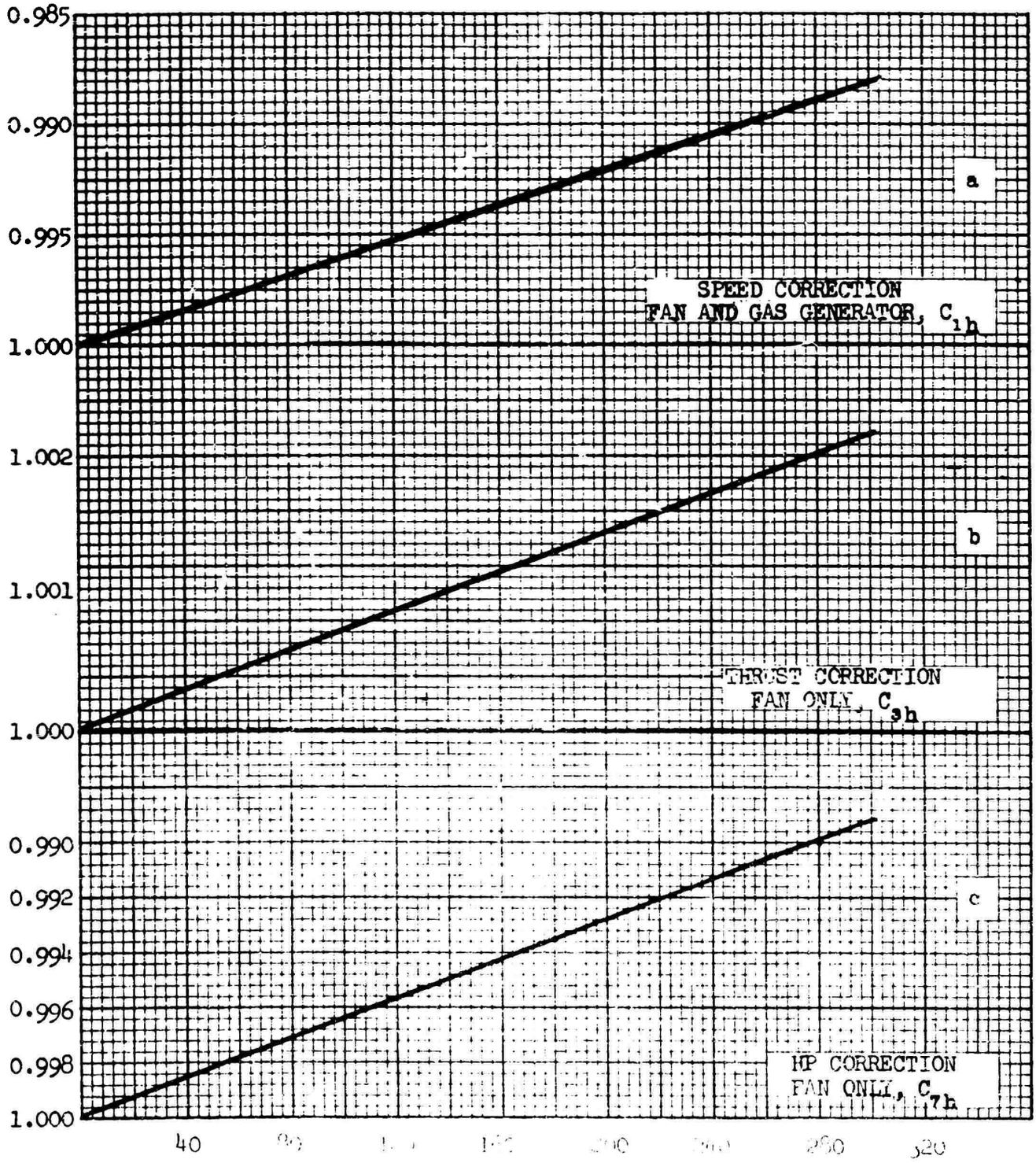
Custodian:
U.S. Army (TRECOM)

Preparing Organization:
The General Electric Company

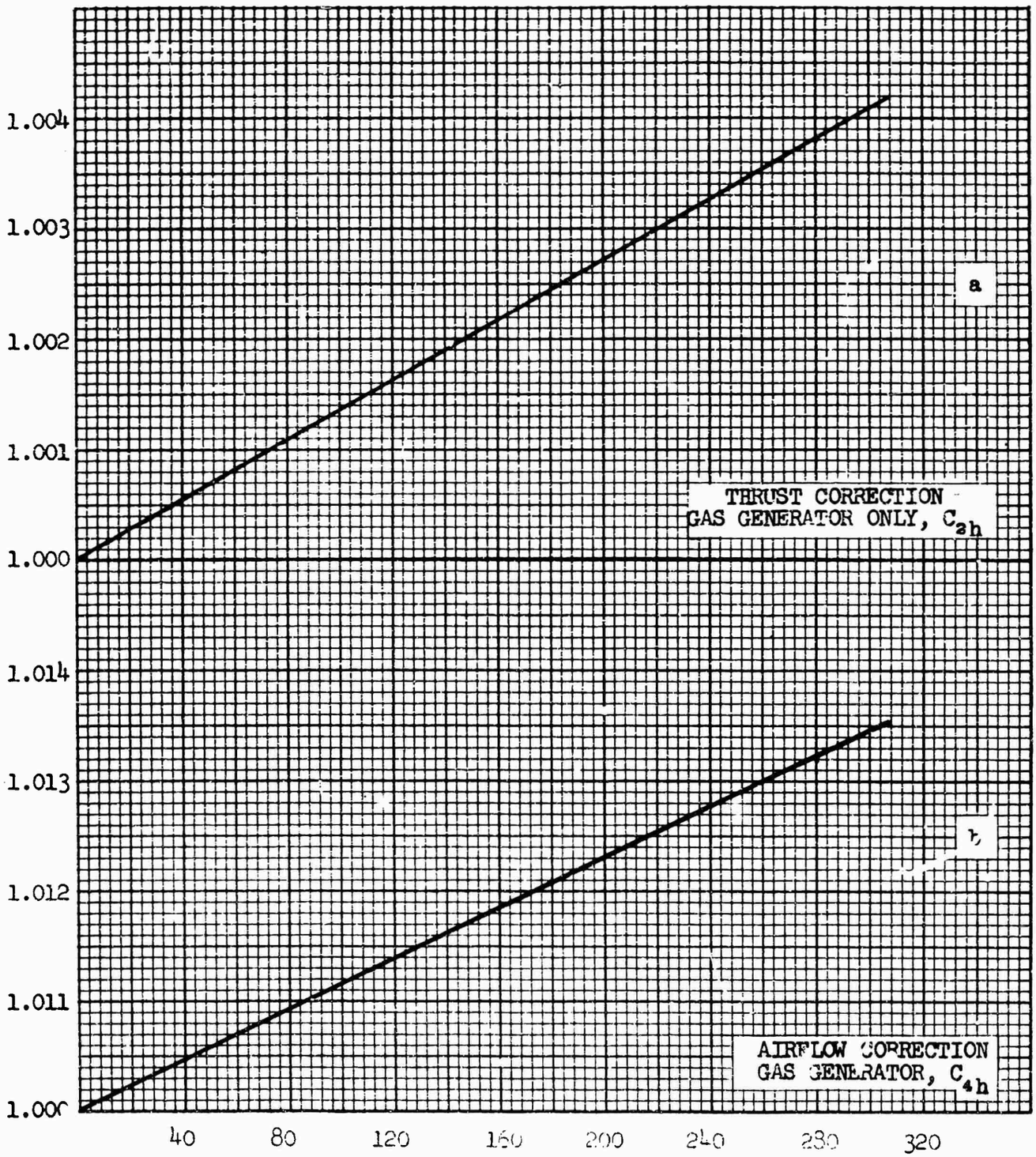


Frequency response characteristics

Figure 1

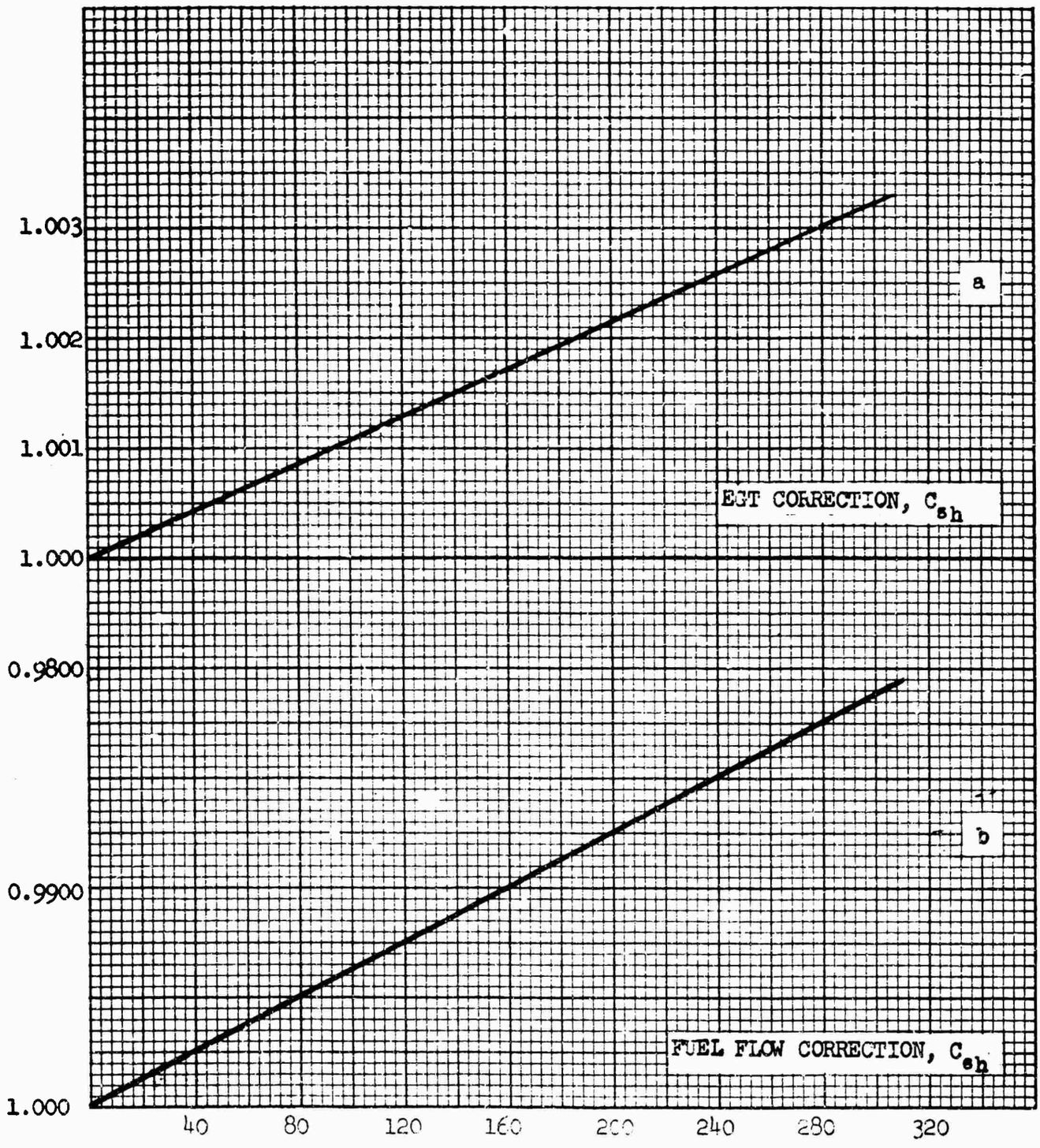

0.985
0.990
0.995
1.000
1.002
1.001
1.000
0.990
0.992
0.994
0.996
0.998
1.000
a
SPEED CORRECTION
FAN AND GAS GENERATOR, C_{1h}
b
THRUST CORRECTION
FAN ONLY, C_{3h}
c
HP CORRECTION
FAN ONLY, C_{7h}
40
520

LB. OF DRY AIR



HUMIDITY CORRECTION FACTORS

Figure 3 a, b



HUMIDITY CORRECTION FACTORS

Figure 4 a, b